

POLICY UPDATE

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Advanced Clean Cars II: The next phase of California's Zero-Emission Vehicle and Low-Emission Vehicle regulations

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INTRODUCTION

The Zero Emission Vehicle (ZEV) and Low Emission Vehicle (LEV) programs of California's Advanced Clean Cars (ACC) regulations,¹ originally enacted in 2012 for model years (MYs) 2015 to 2025 for light-duty and medium-duty vehicles,² have been effective policies for creating and growing the market for electric vehicles (EVs) and reducing road transport greenhouse gas (GHG) and criteria pollutant emission.

Due to California's earlier efforts on vehicle emission regulations pre-dating the 1970 United States Clean Air Act (CAA), the CAA authorized the state to set its own separate and stricter regulations than the federal level. Under Section 177 of the CAA, other states can adopt California standards or follow federal standards, but not set their own. As of September 2022, 15 other states have adopted both California ACC LEV and ZEV regulations, and two states, have adopted LEV regulations.³

1 California Air Resources Board (CARB), Advanced Clean Cars program – About, accessed September 30, 2022, <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about>

2 Passenger cars and light-duty trucks are light-duty vehicles with gross vehicle weights rating (GVWR) less than 8,500 lbs., medium-duty passenger vehicles are light-duty vehicles with GVWR between 8,500 and 10,000 lbs., and medium-duty vehicles are heavy-duty vehicles class 2b that has GVWR between 8,500 and 10,000 lbs., and class 3 that has GVWR between 10,000 and 14,000 lbs. ZEV and LEV regulation applies to light-duty vehicles and only LEV regulations applied towards medium-duty vehicles under ACC and ACC II regulations

3 CARB, "States that have adopted California's vehicle standards under Section 177 of the Federal Clean Air Act," May 13, 2022, https://ww2.arb.ca.gov/sites/default/files/2022-05/%C2%A7177_states_05132022_NADA_sales_r2_ac.pdf

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California adopted the new Advanced Clean Cars II regulations (ACC II) during the California Air Resource Board (CARB) hearing on August 25, 2022.⁴ The ACC II is a bundle of regulations that sets annual ZEV sales requirements from MY 2026 to MY 2035 (ZEV program) and increasingly more stringent exhaust and evaporative emission standards (LEV program) to ensure automakers gradually phase out new sales of internal combustion engine (ICE) vehicles. These regulations provide legal force to the Governor's target of 100% of new light-duty vehicle sales being ZEVs by 2035, including plug-in hybrid vehicles.⁵ It is estimated that ACC II will reduce emissions in California by approximately 69,900 tons of nitrous oxides (NO_x) and 4,500 tons of particulate matter (PM_{2.5}) from 2026 to 2040. The avoided carbon dioxide-equivalent (CO₂-e) emissions from the policy is estimated to be approximately 395.1 million from 2026 to 2040.⁶ For vehicles starting in MY 2035 (MY 2035+), the total cost of ownership savings for consumers can be as much as \$7,900 for the first 10 years.⁷

This policy update discusses the key provisions of the ZEV and LEV programs in ACC II and how they differ from ACC.

ZEV REGULATION DESIGN

This section summarizes the ZEV program and explains the differences between the ACC and ACC II ZEV program provisions. For historical context, the ZEV requirement that specified the percentage of passenger cars and light-duty trucks to be ZEVs with no exhaust or evaporative emissions was first adopted in 1990 as part of the LEV I regulation. This requirement underwent several modifications since its inception.⁸ In 2012, two separate ZEV and LEV programs were established and housed under the ACC regulation. Both programs identify ZEVs as vehicles that do not produce exhaust emissions of criteria pollution and greenhouse gas, such as battery electric vehicles (BEVs) or fuel cell electric vehicles (FCEVs). Although plug-in hybrid vehicles (PHEVs) are not zero-emission vehicles, these programs include PHEVs in the calculation of the state's ZEV credit (ACC) or value (ACC II) percentage requirement.

ZEV CREDIT/VALUE PERCENTAGE REQUIREMENTS

For a given model year, each manufacturer that delivers more than 4,500 light-duty vehicles (LDVs) annually, including passenger cars (PCs), light-duty trucks (LDTs), and medium-duty passenger vehicles (MDPVs) in California must comply with the ZEV program requirement, calculated as the multiplication of the annual credit (ACC) or value (ACC II) percentage requirement shown in Table 1 and the manufacturer's

4 ACC II was approved during CARB's August 25, 2022 meeting, https://cal-span.org/meeting/carb_20220825/. The final regulation documents can be found at California Air Resources Board, Advanced Clean Cars II, <https://ww2.arb.ca.gov/rulemaking/2022/advanced-clean-cars-ii>

5 Office of Governor Gavin Newsome, "Governor Newsome announces California will phase out gasoline-powered cars & drastically reduce demand for fossil fuel in California's fight against climate change," September 23, 2020, <https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/>; CARB, "California moves to accelerate to 100% new zero-emission vehicle sales by 2035," August 25, 2022, <https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035>

6 CARB, "Final Statement of Reasons for Rulemaking, including Summary of comments and agency response" (October 14, 2022), <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/fsor.pdf>

7 CARB, Advanced Clean Cars II Regulation Adoption, Meeting presentation, August 25, 2022, <https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/082522/22-10-1pres.pdf>

8 CARB, Zero-Emission Vehicle program, accessed September 30, 2022, <https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program/about>

production volume. It should be noted that the ACC credit percentage does not reflect sales since BEVs could be eligible for up to 4 credits, as detailed in the section on credits/values per vehicle. Projected ZEV and PHEV sales for ACC were approximately 8% by 2025.⁹ Under ACC II, each vehicle can generate around 1 value (max 1.5 if adding environmental justice values described below), thus more closely reflecting the actual sales.

Table 1. Credit percentage requirements for Advanced Clean Cars and Advanced Clean Cars II

ZEV Regulation	Year	Credit/Value percentage requirement
Advanced Clean Cars	2018	4.5%
	2019	7%
	2020	9.5%
	2021	12%
	2022	14.5%
	2023	17%
	2024	19.5%
	2025	22% (8% projected sales)
Advanced Clean Cars II	2026	35%
	2027	43%
	2028	51%
	2029	59%
	2030	68%
	2031	76%
	2032	82%
	2033	88%
	2034	94%
	2035	100%

Note: ACC credit percentage does not reflect sales since BEV could get up to 4 credits. Under ACC II each vehicle can generate around 1 value (max 1.5 if utilizing the environmental justice value opportunities)

A manufacturer’s LDV production volume for which the manufacturer seeks certification can be calculated based on either the average of the three consecutive previous years or an estimate for the same year. For 2035 and subsequent model years, the production volume will be calculated using the same year method. Manufacturers can choose to earn ZEV values under ACC II for light-duty trucks that change classification to medium-duty trucks due to the increase in weight from the battery, instead of using these values for Advanced Clean Trucks (ACT) regulations.¹⁰

CREDITS/VALUES PER VEHICLE

The original ACC ZEV program included a sliding credit scale based on range, with each ZEV sold earning from 0.5 credits for ZEVs with a 50-mile range under the Urban Dynamometer Driving Schedule (UDDS) test to up to 4 credits for ZEVs with 350 or greater mile electric range. Plug-in hybrid vehicles, referred to as transitional zero

⁹ CARB, “The ZEV regulation factsheet”, https://ww2.arb.ca.gov/sites/default/files/2019-06/zev_regulation_factsheet_082418_0.pdf

¹⁰ The ACT regulation is a ZEV sale requirement for manufacturers that produce medium- and heavy-duty vehicles from Class 2b to Class 8, CARB, Advanced Clean Trucks fact sheet, August 20, 2021, <https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet>

emission vehicles (TZEVs) in the ACC regulation, were eligible for 0.4 credits for PHEVs with a 10-mile UDDS electric range to 1.1 credits for PHEVs with 80 or greater mile UDDS electric range. This design encouraged manufacturers to bring longer-range vehicles to the market.

The new ACC II ZEV program changes the credit structure, with every ZEV sold generally earning 1 vehicle value with opportunities to earn more. These provisions are summarized in Table 2 and explained in more detail in the alternative vehicle value opportunities section. The minimum range for ZEVs is 200 miles certified range using the two-cycle test or 150 miles label range under the five-cycle test.¹¹ ZEVs with less than 200 miles certified range will not be counted in calculating the manufacturer’s annual ZEV requirement but still must meet ZEV assurance measures discussed in the ZEV technical requirements section.

Any MY 2026–2035 PHEV that meets all the technical requirements described in the PHEV technical requirements section, including a minimum 70-mile all-electric certification range, can earn a full credit, called value under ACC II, equivalent to a BEV or FCEV. Additionally, PHEVs with all-electric certification ranging between 43 and 70 miles and meeting all other technical requirements, referred to as transitional PHEVs in this policy update, are allowed to earn close to 1 value in MYs 2026–2028. However, values from PHEVs can only satisfy up to 20% of a manufacturer’s requirements in any given year within MYs 2026–2035.

Table 2. Comparison of key changes from Advanced Clean Cars’ ZEV program credits to Advanced Clean Cars II’s ZEV program vehicle values

Topic	Advanced Clean Cars (MY 2018-2025)	Advanced Clean Cars II (MY 2026-2035)
Credits/Values per ZEV	0.5 – 4	1
Credits/Values per PHEV	0.4 – 1.1	0.63 – 1
Percent of requirement that can be met with PHEVs	Decreasing from 55% in 2018 to 27% in 2025	20%
Minimum zero-emission range	UDDS 50 miles (ZEV), 10 miles (PHEV)	Two-cycle 200 miles (ZEV), 70 miles (PHEV, 43 miles before 2029)

ADDITIONAL ZEV AND PHEV REQUIREMENTS

ZEV technical requirements

Several technical requirements for ZEVs were added for ACC II, including an increase in eligible electric range for value accounting, as shown in Table 2. This increase reflects the rapid development in vehicle technology and is intended to incentivize expanded electric range and functionality for potential consumers. Other notable requirements include an on-board charger of at least 5.76 kW to ensure appropriate charging speed for the larger battery size, a 20-foot Underwriter Laboratory (UL) 2594-certified charging cord that is capable of both Level 1 (120 volt alternating

¹¹ Urban Dynamometer Driving Schedule (UDDS) test plus the first 505 seconds of an additional UDDS, called FTP-75 together, is commonly known as the city test. Highway Fuel Economy Driving Schedule (HWFET) is the highway test. These tests together are two-cycle tests and are used by U.S. EPA for vehicle emissions and fuel economy testing for MY2007 and prior. For consumer label range or fuel economy ratings MY2008+, EPA supplements the city and highway tests with aggressive driving (US06), air-conditioning use (SC03), and a cold temperature driving tests. More information on these tests can be found at U.S. Environmental Protection Agency, Dynamometer Drive Schedules, accessed September 30th, <https://www.epa.gov/vehicle-and-fuel-emissions-testing/dynamometer-drive-schedules>; U.S. Department of Energy, Detailed Test Information, https://www.fueleconomy.gov/feg/fe_test_schedules.shtml.

current [V AC]) and Level 2 (240 V AC) charging, and a required SAE J1772 Combined Charging Standard (CCS) vehicle connector for BEVs. The CCS connector requirement would further standardize charging across the domestic market and allow more charging options for ZEV drivers who do not have convenient home charging access and rely on direct current (DC) fast charging.

Additionally, BEVs and FCEVs are now required to comply with ZEV assurance measures in ACC II. These measures include a durability requirement of 70% of certified range value for 10 years or 150,000 miles for MYs 2026–2029, and 80% of certified range value for 10 years or 150,000 miles for MYs 2030+, and a battery warranty requirement of 8 years or 100,000 miles, with 70% battery state of health for MYs 2026–2030 or 75% for MYs 2031+. Other requirements include a propulsion-related parts warranty for 3 years or 50,000 miles, 7 years or 70,000 miles for high-priced parts, service information disclosure to independent repair shops, and battery labeling for recyclability and repurposing.

PHEV technical requirements

ACC II also adds several requirements for PHEVs. Under ACC, PHEVs are required to have at least 10 miles of all-electric range under the UDDS test and meet super-ultra-low-emission (SULEV) engine emission standards or limits of 0.030 grams per mile (g/mile).¹² To earn a full value, PHEVs from MY 2026 must have a minimum of 70 miles all-electric certification range (roughly 50-mile consumer label range), and 40 miles all-electric certification range on the US06 drive schedule—an aggressive test cycle that indicates that the vehicle can run on electric power under any normal driving conditions. PHEVs are required to have a higher power on-board charger power, a convenience cord, and assurance measures at the same values as the ZEV technical requirements. The extended defects and performance warranty for 15 years or 150,000 miles and J1772 requirement for Level 2 charger remain the same as ACC.

ACC II also includes a 3-year phase in option for transitional PHEVs, allowing MY 2026–2028 PHEVs with a greater than 43-mile but less than 70-mile all-electric certification range that meet other technical requirements to be eligible for the value. These vehicles receive lower values in ACC II compared to ACC and are capped at 1 value each before taking alternative vehicle value opportunities into account.¹³ Like the PHEVs for MYs 2026+ which earn one value, these transitional PHEV credits fall under the 20-percent PHEV cap and expire after 5 years (including its model year). Starting in MY 2029, all PHEVs are required to have at least a 70-mile range to be eligible for the ACC II value.

ALTERNATIVE VEHICLE VALUE OPPORTUNITIES

Environmental justice vehicle values. ACC II provides opportunities for limited extra values through the environmental justice (EJ) value provision. The EJ provision allows automakers to earn more than 1 value per vehicle as early as 2024, as described

¹² More details on SULEV standards under California's latest Low-Emission-Vehicle III (LEV III) regulations for MY 2015 to 2025 can be found in CARB, "The California Low-Emission Vehicle Regulations," accessed September 30, 2022, <https://ww2.arb.ca.gov/sites/default/files/2019-07/cleancomplete%20lev-ghg%20regs%2010-19.pdf>

¹³ The credits for these transitional PHEVs will be calculated by dividing the all-electric label range by 100 and then adding a value of 0.2. If the vehicle can run 10 miles all-electric on US06 driving schedule, it earns an additional 0.15 vehicle credit. These credit or value calculation is different between ACC and ACC II. A PHEV produced in 2026 with 43 all-electric miles certification range and US06 capable for 10 miles would receive 0.78 value ($0.78 = 43/100 + 0.2 + 0.15$). In ACC, this PHEV can earn 0.93 credits ($0.93 = 43/100 + 0.3 + 0.2$) under the same parameters.

in Table 3 below. The objective in all cases is to ensure that ZEVs are distributed across the whole of California’s population, and particularly to minority populations and those living in communities burdened by air pollution. All price requirements are adjusted annually for inflation and these EJ values may not be transferred to be used in other Section 177 states to meet their compliances. These flexibilities are concentrated in the early years of the regulation, with all three options ending by 2031. Importantly, a manufacturer may earn no more than 5% of their annual vehicle value requirements in any year through any combination of EJ credits.

Table 3. Summary of environmental justice value opportunities

Credit opportunity	Requirements	Additional vehicle value	Time period
Community-based clean mobility programs	<ul style="list-style-type: none"> EVs must be sold at a 25% discount off the manufacturer’s suggested retail price (MSRP) Program must be implemented by local community-based organization (determined by CARB) or Native American tribe 	0.5 per BEV, 0.4 per PHEV	MY 2024-2031
Re-selling of EV post-lease in California	<ul style="list-style-type: none"> ZEV must have had a MSRP no more than \$40,000 at first sale Must be sold used at dealership participating in financial assistance programs 	0.1 or 0.25	0.1 for original sale of MY 2026-2028 and 0.15 for the second sale to program participant no later than 2031
Selling low-price EVs	<ul style="list-style-type: none"> ZEV MSRP must be no greater than \$20,275 (car) or \$26,670 (light truck) 	0.1	MY 2026-2028

Early compliance values. ACC II includes an additional provision to incentivize ZEV sales in the near-term before the regulation takes effect. These early compliance values can be generated in the two model years before the start of the program and are based on manufacturer’s excess ZEV and PHEV sales in each of those two model years. For example, these two model years would be MY 2024 and MY 2025 in California. Other Section 177 states that adopt ACC II later could have different start year. Under this provision, all sales over the 20% threshold accumulate ZEV values in the prior two model years can be used for the first three model years after the start of the ACC II program. The value is capped at 1 for ZEV and less than or equal to 1 for PHEV, depending on its electric range and based on ACC II PHEV value calculation. The maximum allowance of these values is 15% of model year’s annual requirement.

Proportional fuel cell electric vehicle values.

Proportional FCEV values from ACC for California or a Section 177 state are continued in ACC II until 2030 with some differences in the calculation method. Under ACC I, the proportional FCEV value for a model year in a section 177 state is calculated by multiplying the ratio between the manufacturer’s LDV production volume in the state and California with the full FCEV credits earned in California. Under ACC II, the proportional FCEV values of the manufacturer in a state is the result of the annual FCEV allowance, minus the vehicle values earned from FCEVs in that state. The manufacturer’s annual FCEV allowance (in number of vehicles) in a state is calculated by multiplying the highest FCEV percentage share among California and Section 177 states,¹⁴ or 10 percent, whichever is smaller, with the annual

¹⁴ A manufacturer’s FCEV percentage share in a model year in a state is calculated by its total FCEV volume sold in that year divided by its ZEV volume requirement of that year in that state.

ZEV vehicle volume requirement for that model year in that state.¹⁵ These values may only be used in the same model year and state that they are earned to make up the manufacturer's deficits.

CREDIT/VALUE ACCOUNTING

Banking. ACC II introduces some new provisions for value banking. Under ACC, manufacturers may bank excess credits for future use for compliance for MYs 2018–2025. Under ACC II, banked values may only be used for 4 model years after originally accrued (e.g., an extra model year 2026 ZEV could be used to fulfill requirements through model year 2030) and thereafter expire. Values earned through different mechanisms (e.g., ZEV sales, PHEV sales, EJ values) are banked separately. Values from previous years, including credits from ACC, may be used to satisfy an annual ZEV requirement only when all value opportunities earned during that model year are exhausted. The sum of these “roll-over” BEV and PHEV credits from ACC will be divided by 2.1.

A manufacturer can only elect one of two methods to determine the allowances for converted values used in its requirement in a model year. The first method is an annual allowance, in which these converted pre-2026 values may only be used to satisfy up to 15% of a manufacturer's value requirement in a model year and will all expire following the 2030 model year. The second method is a cumulative allowance that is linked with the use of EJ values available in MYs 2026–2028 and gives automakers more flexibility in the early years. Based on the EJ threshold, the maximum allowance can be 15% of the manufacturer's annual ZEV requirement in each model year, or a larger amount of the calculated cumulative allowance across the 5 years can be used to offset the requirement in a year while the remainders are spread over the subsequent years. If the manufacturer's EJ values reach 0.5% of its annual ZEV value requirement (EJ threshold) in one of the MYs 2026–2028, the first three model years can use the converted values up to the maximum cumulative allowance; if two of the MYs 2026–2028 reach the EJ threshold, the first 4 model years can use the maximum allowance; if all three satisfy the threshold, all 5 years can use the maximum allowance.

Trading and pooling. All types of compliance values can be traded with another automaker within the state where the manufacturers earn the values; the expiration dates of banked, converted, and early compliance credits are unaffected by a trade. ACC and ACC II allow a manufacturer to “pool” or transfer excess ZEV and PHEV credits or values earned in one state to another state that has a shortfall in ZEV requirements. In ACC, California was not allowed to participate in pooling; in ACC II, it is. The pooled allowance for an automaker—the portion of values that can be received from out of state—in ACC II is 25% in MY 2026, declining at 5% intervals to 5% in MY 2030. Trading and pooling can be used together to help manufacturers navigate the ZEV value market and comply with states' ZEV requirements. For example, a manufacturer can purchase vehicle values from other manufacturers within state A to

¹⁵ Calculation example for proportional FCEV values: Assume Automaker A sells 5,000 FCEVs in 2026 in California and also the most FCEVs out of California and Section 177 states. If Automaker A is required to make 100,000 ZEV in California in 2026 (35% of their production for sales in California), then the FCEV percentage share would be 5% which is smaller than 10%. Therefore, 5% would be Automaker A's annual proportional FCEV allowance for all Section 177 states. Now we look at one Section 177 state in details. Assume Automaker A sells 300 FCEV in 2026 in Massachusetts, and it is required to sell 40,000 ZEVs in this state. Its proportional FCEV allowance based on previous calculation is 5% of that 40,000, which is 2,000 vehicles. Automaker A earns the proportional FCEV values based on the subtraction of 2,000 and 300, which is 1,700.

comply with the requirement in that state. It would free up the vehicle values earned by that manufacturer from state A, now excess values, to be transferred to another state.

Deficits and penalties. ACC and ACC II are generally similar in their enforcement mechanisms. Automakers may accrue and maintain a ZEV credit or deficit for a particular model year for up to 3 years. If the automaker is not able to recover the deficit by the fourth year, they are subject to a civil penalty. Through MY 2025 (ACC), the penalty is \$5,000 per ZEV credit. Through 2021, no automaker has had to pay a penalty. For MYs 2026–2035, the penalty is \$20,000 per ZEV value.

DEROGATIONS

ACC and ACC II both exempt small volume manufacturers (SVM) delivering fewer than 4,500 light-duty vehicles annually in California. However, SVMs can still earn, bank, and trade ZEV values for vehicles delivered for sale in California. Starting in 2035, the SVMs must comply with the 100% ZEV sales requirement, with maximum 20% of requirements from PHEVs.

Automakers selling more than 4,500 vehicles per year, calculated as the average of the prior 3 years, but fewer than 20,000 in California (or fewer than 60,000 prior to changes in the 2017 midterm evaluation of regulations) are considered intermediate volume manufacturers (IVMs) under ACC.¹⁶ IVMs face the same absolute credit percentage requirements under ACC but may meet up to 100% of their credit requirements through PHEVs. However, ACC II discontinues the IVMs distinction, thus IVMs fall under the ZEV value requirements for automakers that sell more than 4,500 vehicles per year.

LEV REGULATION DESIGN

This section focuses on the updates to the LEV greenhouse gas, criteria pollutant, and evaporative emission regulation designs in the ACC II Low Emission Vehicle IV regulations (LEV IV) for MYs 2026+, compared to ACC LEV III for MYs 2015–2025. The vehicles under the regulations are LDVs and medium-duty vehicle (MDVs) class 2b and 3—an addition compared to the ZEV program. The LEV IV regulation introduces more stringent emission standards and several additions and changes to the test procedures for both LDVs and MDVs, compared to ACC LEV III.

LIGHT-DUTY VEHICLES

Greenhouse gas (GHG) emission standards

CARB's LEV program has been mostly aligning with the U.S. Environmental Protection Agency greenhouse gas emission standards since MY 2012, except for MYs 2021–2022, in which federal regulation was weakened by the Safer Affordable Fuel Efficiency (SAFE) rule.¹⁷ CARB's program did not align with the SAFE rule and, thus, the California's GHG emission standards remain as adopted per President Obama

¹⁶ CARB, "The California Low-Emission Vehicle Regulations," accessed September 30, 2022, <https://ww2.arb.ca.gov/sites/default/files/2019-07/cleancomplete%20lev-ghg%20regs%2010-19.pdf>

¹⁷ The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 85 Fed. Reg. 84, (April 30, 2020), <https://www.govinfo.gov/content/pkg/FR-2020-04-30/pdf/2020-06967.pdf>

administration's federal standards.¹⁸ As of 2022, the federal GHG emission standards were extended to MY 2026 and are waiting for the next round of rulemaking for MYs 2027+.¹⁹

Criteria pollutant and evaporative emission standards

The LEV regulations require manufacturers to certify their vehicles' greenhouse gas, criteria pollutant exhaust (tailpipe), and evaporative emissions by test groups to sell vehicles in California. Each test group must meet the emission standards; in other words, no vehicles in the test group shall exceed the limits set under each laboratory test cycle. The criteria pollutant test cycles include the Federal Test Procedures (FTP) cycle, or FTP-75, the Highway Fuel Economy Driving Schedule (HWFET), and the Supplementary FTP (SFTP) cycles.

The FTP cycle demonstrates compliance under typical urban driving conditions at laboratory temperature between 68 °F to 86 °F. There is also a separate FTP cold temperature test at 20 °F for carbon monoxide (CO) compliance. The Supplementary FTP (SFTP) tests include the US06 cycle, which accounts for aggressive driving conditions under the same FTP temperature range, the SC03 cycle, which demonstrates emissions under air conditioning use at 95 °F with full sunload, and the Hot 1435 UC test that replaces the US06 test for class 3 MDVs. The Hot 1435 UC test simulates a traveling pattern of higher speed, higher acceleration, fewer stops per mile, and less idle time. CARB also has multi-day diurnal, hot soak, and running loss evaporative tests to limit the fuel vapors escaping the vehicle's evaporative system, rather than the exhaust emission.

CARB provides flexibility to manufacturers by allowing certification of each test group to different vehicle emission "categories" as long as the sales-weighted average of the emission categories meets the overall standards for each model year. Table 4 shows the FTP low and high altitude combined non-methane organic gas and oxides of nitrogen (NMOG+NO_x), CO, formaldehyde (HCHO), and PM emission standards for LDVs by emission category for LEV III and LEV IV. The number that follows each LEV category denotes the vehicle emission category (or bin). In most cases, this corresponds to the NMOG+NO_x emission value in thousands of grams per mile (g/mile). Compared to LEV III, LEV IV removes the LEV160 category, adds the ULEV60, ULEV40, SULEV25, and SULEV15 categories, and has more stringent low altitude NMOG+NO_x, CO, and PM emission standards. Under HWFET or highway driving conditions, NMOG+NO_x emissions must not be greater than shown in the table for each emission category.

¹⁸ CARB, Proposed Amendments to the Low-Emission Vehicle III Greenhouse gas regulation, accessed September 30, 2022, <https://ww2.arb.ca.gov/rulemaking/2018/proposed-amendments-low-emission-vehicle-iii-greenhouse-gas-emission-regulation>

¹⁹ More information on the U.S. EPA GHG emission regulation can be found at Anh Bui and Zifei Yang, "U.S. light-duty vehicle greenhouse gas emission standards for Model years 2023-2026 and Corporate average fuel economy standards for model years 2024-2026," (ICCT: Washington DC, 2022), <https://theicct.org/publication/update-us-ghg-cafe-standards-jul22/>.

Table 4. Federal Test Procedure exhaust emission standards for light-duty vehicles under 75°F conditions

LEV regulation	Vehicle emission category	Low altitude NMOG +NO _x (g/mile) ^x	High altitude NMOG + NO _x (g/mile) ^x	CO (g/mile)	HCHO (g/mile)	PM ^c (g/mile)
LEV III	LEV160 ^a	0.160	0.160	4.2	0.004	0.003
	ULEV125 ^a	0.125	0.125	2.1	0.004	0.003
	ULEV70	0.070	0.105	1.7	0.004	0.003
	ULEV50	0.050	0.070	1.7	0.004	0.003
	SULEV30	0.030	0.060	1.0	0.004	0.003
	SULEV20	0.020	0.050	1.0	0.004	0.003
LEV IV	ULEV125	0.125	0.160	2.1	0.004	0.001
	ULEV70	0.070	0.105	1.7	0.004	0.001
	ULEV60 ^b	0.060	0.090	1.7	0.004	0.001
	ULEV50	0.050	0.070	1.7	0.004	0.001
	ULEV40 ^b	0.040	0.060	1.7	0.004	0.001
	SULEV30	0.030	0.050	1.0	0.004	0.001
	SULEV25 ^b	0.025	0.050	1.0	0.004	0.001
	SULEV20	0.020	0.030	1.0	0.004	0.001
SULEV15 ^b	0.015	0.030	1.0	0.004	0.001	

^a LEV160 category is removed from LEV IV and ULEV125 is applicable for MYs 2026–2028 for manufacturers other than small volume manufacturers (SVMs). For a SVM, it is available until 2034.

^b ULEV60, ULEV40, ULEV25, and ULEV15 categories are added in LEV IV

^c LEV III and LEV IV both have a phase-in schedule for PM emission standards until they reach the numbers shown in the table

The PM emission standard is the same for each emission category, but phases in over time. For LEV III, in MY 2017, 10% of vehicles must meet the 0.003 g/mile PM standards, while the rest must meet the 0.010 g/mile standards and phase in to 100% 0.003 g/mile from MYs 2021–2024. By MY 2025, 25% of the vehicles must meet the 0.001 g/mile standard while the rest must meet the 0.003 g/mile standard. For LEV IV, 50% of vehicles must meet the 0.001 g/mile standard in 2026, 75% in MY 2027, and 100% in MYs 2028+. For MYs 2026 to 2028, an interim in-use compliance standards of 0.002 g/mile is available for the first two model years a vehicle emission category certified to the 0.001 g/mile standards. This flexibility provides manufacturers extra margin for compliance in the first few years.²⁰ SVMs only need to meet the 100% 0.001 g/mile requirement in MYs 2028+, while certify 100% to 0.003 g/mile standard in 2026 and 2027.

Besides certifying vehicles to their vehicle emission category, manufacturers also must certify all light-duty vehicles to the fleet average NMOG+NO_x standards, which is 0.03 g/mile in LEV IV. Crediting of ZEVs towards fleet average calculation phases down from 100% in MY 2025 to 0% in MY 2029, and PHEV emissions are adjusted based on a formula prior to MY 2029. The overall standards are shown below in Figure 1. LEV III has two separate standards for PCs and LDTs with a GVWR of more than 6,000 lbs (LDT1) and LDTs with a GVWR of 6,000 to 8,500 lbs. (LDT2), while LEV IV combines the two categories.

²⁰ CARB, In-use compliance programs, accessed September 30, 2022, <https://ww2.arb.ca.gov/light-duty-in-use-compliance-programs>

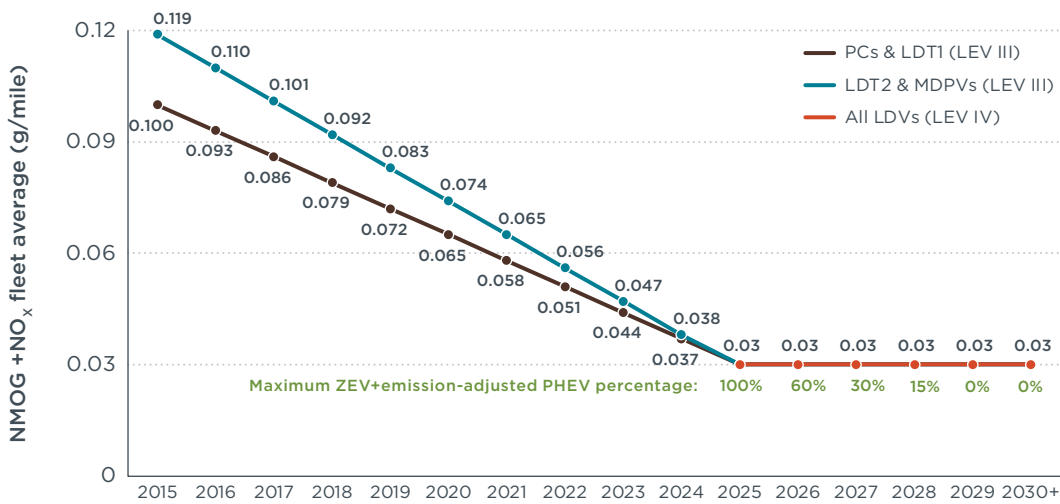


Figure 1. Fleet average NMOG+NO_x standards for light-duty vehicles under California LEV III and LEV IV regulations

Other changes to criteria pollutant and evaporative emission test procedures and standards for LDVs

LEV IV introduces several changes to the test procedures and more stringent standards used to certify vehicles in California:

- » **FTP Partial soak.** CARB tests under FTP conditions have shown that partial soak, in the range of the vehicle being parked and cooled down for 30 minutes to 3 hours, can result in higher emissions than full soak in which vehicles have been cooled to ambient temperature for 12–36 hours. To account for these conditions, LEV IV adds additional NMOG+NO_x emission tests for 10-minute, 30-minute, and 3-to-12-hour partial soaks. The 10-minute soak NMOG+NO_x emission category limits range from 0.063 to 0.008 g/mile, the 40-minute soak limits range from 0.096 to 0.012 g/mile, and 3-to-12-hour soak limits range from 0.125 to 0.015 g/mile as the vehicle emission category becomes stricter.
- » **FTP Quick drive-away.** Another test added in LEV IV FTP standards to better represent vehicle in-use conditions is quick drive-away, in which vehicles are idled for 8 seconds. CARB tests have shown that vehicles that are idled less than 20 seconds before the start of the regular FTP test result in higher NMOG+NO_x emissions. The emissions category standards for this test range from 0.125 to 0.027 g/mile as the vehicle emission category gets stricter.
- » All manufacturers, except SVMs, must certify a percentage of their projected vehicle sales to the Partial soak and Quick drive-away standards based on a phase-in schedule, which is 30% of vehicles in MY 2026, 60% in MY 2027, and 100% in MYs 2028+. A SVM may certify 100% of its vehicles to the partial soak and quick drive-away standards in MYs 2030+. Interim in-use compliance standards with a 1.2 times higher emission limit for each vehicle category for quick drive-away standards are provided for MYs 2026–2028.

- » **FTP 50° F condition.** FTP test under 50° F conditions is used in both LEV III and LEV IV for all LDVs, except for natural gas and diesel-fueled vehicles. LEV III distinguished NMOG+NO_x standards for gaseous and alcohol fuel, ranging from 0.320 to 0.040 g/mile for gasoline and 0.320 to 0.075 g/mile for alcohol fuel. Under LEV IV, the standards become stricter, range from 0.250 to 0.030 g/mile for both types of fuel.
- » **SFTP US06 and SC03.** Under LEV III, manufacturers can opt for the composite FTP, US06, and SC03 emission standards instead of the stand-alone standards for US06 and SC03.²¹ CARB staff's analysis have shown that for a small portion of the fleet, the composite method underestimated emissions during aggressive driving that can occur more frequently during real world operation. LEV IV eliminates this option and adds requirements for stand-alone SFTP NMOG+NO_x and CO emissions, using emission limits by emission category, shown in Table 5. It also creates unique limits for all nine LEV IV vehicle emission categories, instead of just three categories for LEV, ULEV, and SULEV in LEV III.

Table 5. Supplemental Federal Test Procedures (US06 and SC03 cycle) emission standards for light-duty vehicles

LEV regulation	Vehicle emission category	Option 1: Stand-Alone standards					Option 2: Composite	
		US06 test			SC03 test		Fleet average	
		NMOG +NO _x (g/mile) ^a	CO (g/mile)	PM (g/mile) ^b	NMOG +NO _x (g/mile)	CO (g/mile)	NMOG +NO _x (g/mile)	CO (g/mile)
LEV III	LEV	0.140	9.6	0.010 g/mile for PCs +LDT1; 0.020 g/mile for LDT2+MDPVs	0.100	3.2	Decrease from 0.140 in 2015 to 0.050 in 2025	4.2
	ULEV	0.120	9.6		0.070	3.2		
	SULEV	0.050	9.6		0.020	3.2		
LEV IV	ULEV125	0.125	9.6	0.003	0.125	2.1		
	ULEV70	0.070	9.6	0.003	0.070	1.7		
	ULEV60	0.060	9.6	0.003	0.060	1.7		
	ULEV50	0.050	9.6	0.003	0.050	1.7		
	ULEV40	0.040	9.6	0.003	0.040	1.7		
	SULEV30	0.030	9.6	0.003	0.030	1.0		
	SULEV25	0.030	9.6	0.003	0.025	1.0		
	SULEV20	0.030	9.6	0.003	0.020	1.0		
	SULEV15	0.030	9.6	0.003	0.015	1.0		

^a US06 NMOG+NO_x standards have a phase-in schedule, which is 70% of the MY 2026 vehicles certified to a 1.2 times higher standards, 40% in MY 2027, and 0% in MYs 2028+, while the rest follow the final standards

^b US06 PM standards have a phase-in schedule from 100% at 0.006 g/mile in MY2026 to 100% at 0.003 g/mile in MYs 2030+

- » A NMOG + NO_x interim in-use compliance standards similar to the 1.2 times higher standards as noted under Table 5 is available for vehicles certified to the final standards in MYs 2026 and 2027. A SVM may certify to the final NMOG+ NO_x and CO standards starting in MY 2030 and to the interim standards prior. The higher interim in-use compliance US06 PM standards of 0.004 g/mile are available in

21 Composite emission value = 0.28 x US06 + 0.37 x SC03 + 0.35 x FTP

MYs 2026–2029 for vehicles certified to 0.003 g/mile. A SVM may certify 100% of its LDV fleets to the 0.006 g/mile PM standards for MYs 2026–2029, and 100% to 0.003 g/mile for MYs 2030+.

- » **SFTP Cold start US06.** LEV IV adds another SFTP test to represent more vehicle in-use conditions, especially for PHEVs. Eligible PHEV with minimum zero-emission range shown in Table 2, and meets a US06 all-electric range of at least 10 miles in MY 2026–2028 and 40 miles in MY 2029+ is exempt from the requirement. The Cold Start US06 test simulates a driving condition in which there is an initial aggressive start of the engine requiring significant power and torque that the battery cannot fully provide. The high-power cold start standards are split into two schedules, higher maximum NMOG+NOx emission for MYs 2026–2028, ranging from 0.350 to 0.075 g/mile depending on emissions category and lower emissions standard values for MYs 2029+, ranging from 0.250 to 0.050 g/mile.
- » **Evaporative emission standards.** The main change is the standard for running loss, or evaporative emissions escaping during driving. Since its introduction in 1990, the standard of 0.05 grams of hydrocarbons per mile has not changed. According to 2019 models' certification data, 87% of vehicles were emitting at or below 0.01 g/mile.²² Thus, under LEV IV, the running loss standard reduces to 0.01 g/mile.

MEDIUM-DUTY VEHICLES

Greenhouse gas emission standards

MDVs' Class 2b and 3 greenhouse gas emission standards are covered under the federal Medium and Heavy-duty vehicle standards Phase 1 for MYs 2014–2018 and Phase 2 for MYs 2018–2027.²³

Criteria pollutant exhaust emission standards

There are separate LEV IV criteria pollutant and evaporative emission standards for Class 2b and for Class 3 MDVs. Similar to LDV, there are multiple emission categories that each test group may be certified to meet, as long as the sales-weighted average of the emission categories meets the overall standards for each model year.

Table 6 shows the FTP NMOG+NOx, CO, HCHO, and PM emissions category standards for Class 2b, in different LEV, ULEV, and SULEV vehicle emission categories. Compared to LEV III, LEV IV removes the LEV395 and ULEV340 categories, keeps ULEV250 and ULEV200 only for MYs 2026–2028, and adds four more SULEV125, SULEV100, SULEV85, SULEV75 emission categories. It also has more stringent NMOG+NOx, CO, and PM emission standards. Similar to LDV standards, under HWFET or highway driving conditions, MDVs' NMOG+NOx emissions must not be greater than the value shown in the table for each emission category.

22 CARB, "Staff report: Initial statement of reasons," (April 12, 2022), <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf>

23 U.S. EPA, Final rule for Phase 1 greenhouse gas emissions standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles, accessed September 30, 2022, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-1-greenhouse-gas-emissions-standards>; U.S. EPA, Final rule for Phase 2 greenhouse gas emissions standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles, accessed September 30, 2022, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-2-greenhouse-gas-emissions-standards#:~:text=Rule%20Summary,-The%20U.S.%20Environmental&text=The%20final%20standards%20are%20expected,vehicles%20sold%20under%20the%20program>

Table 6. Federal Test Procedure exhaust emission standards for Class 2b medium-duty vehicles

LEV regulation	Vehicle emission category	NMOG +NOx (g/mile)	CO (g/mile)	HCHO (g/mile)	PM ^c (g/mile)
LEV III	LEV395 ^a	0.395	6.4	0.006	0.008
	ULEV340 ^a	0.340	6.4	0.006	0.008
	ULEV250	0.250	6.4	0.006	0.008
	ULEV200	0.200	4.2	0.006	0.008
	SULEV170	0.170	4.2	0.006	0.008
	SULEV150	0.150	3.2	0.006	0.008
LEV IV	ULEV250 ^a	0.250	6.4	0.006	0.008
	ULEV200 ^a	0.200	4.2	0.006	0.008
	SULEV170	0.170	4.2	0.006	0.008
	SULEV150	0.150	3.2	0.006	0.008
	SULEV125 ^b	0.125	3.2	0.006	0.008
	SULEV100 ^b	0.100	3.2	0.006	0.008
	SULEV85 ^b	0.085	3.2	0.006	0.008
	SULEV75 ^b	0.075	3.2	0.006	0.008

^a LEV395 and ULEV340 categories are removed, ULEV250 and ULEV200 categories are only applicable for MYs 2026 and 2028 in LEV IV

^b SULEV125, SULEV100, SULEV85, SULEV75 categories are added in LEV IV

^c LEV III has a phase-in schedule for PM emission standards, from 10% at 0.008 g/mile in 2017 to 100% by 2021.

Table 7 shows the NMOG+NOx, CO, HCHO, and PM emissions category standards for class 3 vehicles, in different LEV, ULEV, and SULEV vehicle emission categories. Compared to LEV III, LEV IV removes LEV630 and ULEV570 categories, keeps ULEV400 and ULEV270 only for MYs 2026–2028, and adds four more SULEV175, SULEV150, SULEV125, SULEV100 emission categories. It also has more stringent NMOG+NOx, CO, and PM emission standards.

Table 7. Federal Test Procedure exhaust emission standards for class 3 medium-duty vehicles

LEV regulation	Vehicle emission category	NMOG +NOx (g/mile)	CO (g/mile)	HCHO (g/mile)	PM ^c (g/mile)
LEV III	LEV630 ^a	0.630	7.3	0.006	0.010
	ULEV570 ^a	0.570	7.3	0.006	0.010
	ULEV400	0.400	7.3	0.006	0.010
	ULEV270	0.270	4.2	0.006	0.010
	SULEV230	0.230	4.2	0.006	0.010
	SULEV200	0.200	3.7	0.006	0.010
LEV IV	ULEV400 ^a	0.400	7.3	0.006	0.010
	ULEV270 ^a	0.270	4.2	0.006	0.010
	SULEV230	0.230	4.2	0.006	0.010
	SULEV200	0.200	3.7	0.006	0.010
	SULEV175 ^b	0.175	3.7	0.006	0.010
	SULEV150 ^b	0.150	3.7	0.006	0.010
	SULEV125 ^b	0.125	3.7	0.006	0.010
	SULEV100 ^b	0.100	3.7	0.006	0.010

^a LEV630 and ULEV570 categories are removed, ULEV400 and ULEV270 categories are only applicable for MYs 2026-2028 in LEV IV

^b SULEV175, SULEV150, SULEV125, SULEV100 categories are added in LEV IV

^c LEV III has a phase-in schedule for PM emission standards, from 10% at 0.010 g/mile in 2017 to 100% by 2021.

MDVs in LEV III, has a phase-in schedule that requires manufacturers to increase percentages of MDVs to increasingly more stringent vehicle emission categories (Table 8). Manufacturers can also opt for an alternative stand-alone fleet average emission standards (Figure 2). LEV IV introduces only stand-alone fleet average NMOG+NO_x emission standards for both class 2b and 3 MDVs, shown in Figure 2. SVMs can certify 100% of its MDV fleet to the ULEV250 or ULEV400 for MYs 2026 and 2027, and to the SULEV170 or SULEV230 for MYs 2028+, in lieu of the fleet average requirements shown in the figure for higher volume manufacturers.

Table 8. Federal Test Procedure NMOG+NO_x emission standard phase-in schedule (%) for medium-duty vehicles under LEV III regulations

LEV III	Year	LEV395 or LEV630	ULEV340 or ULEV570	ULEV250 or ULEV400	SULEV170 or SULEV230	ULEV
	2015	40	60	0	0	100
2016	20	60	20	0	100	
2017	10	50	40	0	100	
2018	0	40	50	10	100	
2019	0	30	40	30	100	
2020	0	20	30	50	100	
2021	0	10	20	70	100	
2022+	0	0	10	90	100	

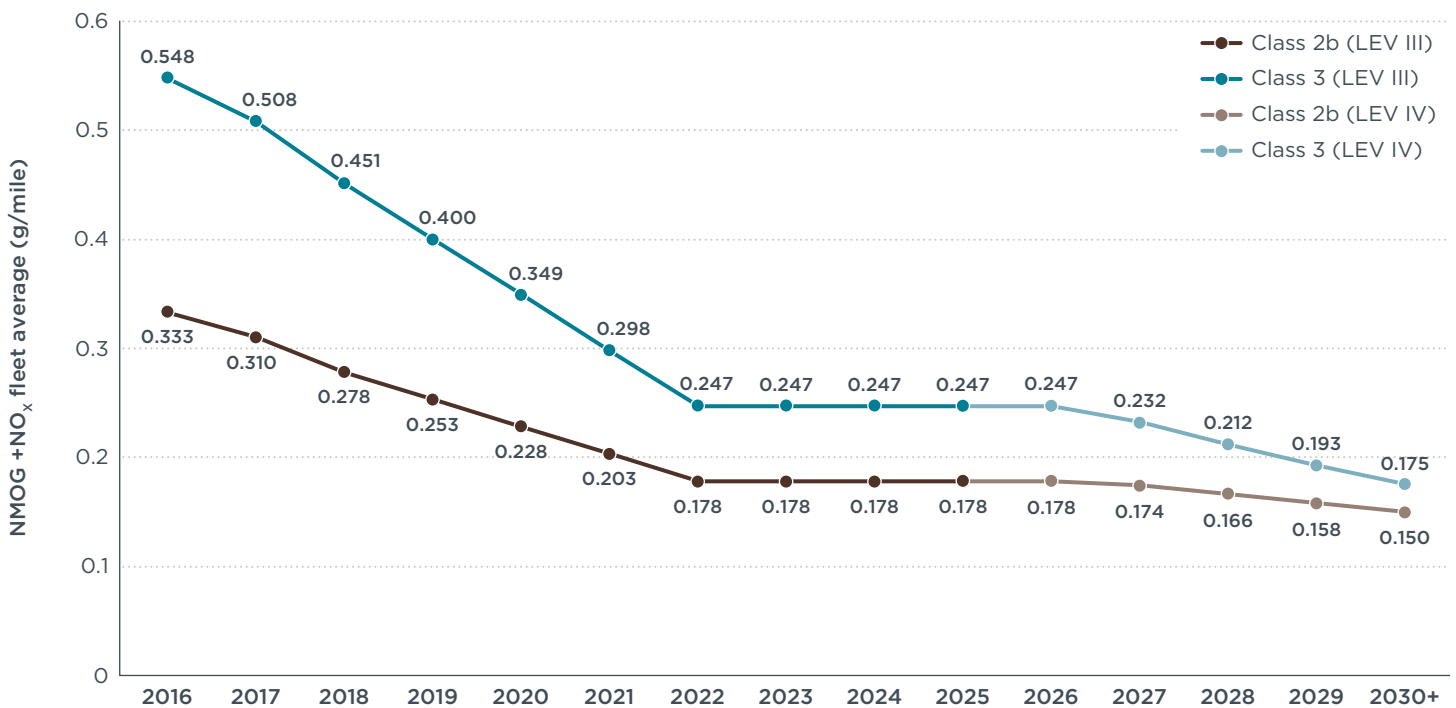


Figure 2. Fleet average NMOG+NO_x emission standards for medium-duty vehicles under California LEV III and LEV IV regulations

Other changes to criteria pollutant and evaporative emission test procedures and standards for MDVs in LEV IV

LEV IV introduces several changes to the test procedures and more stringent standards used to certify MDVs in California:

- » **FTP 50 °F conditions.** Under LEV IV, the NMOG+NO_x standards eliminate the difference between gasoline and alcohol fuel. For class 2b, the NMOG+NO_x emission standards range from 0.500 to 0.150 g/mile, corresponding to the emissions category. HCHO standards are at 0.016 g/mile for all vehicle emission categories, except for ULEV250 at 0.032 g/mile. For class 3, the NMOG+NO_x standards range from 0.800 to 0.200 g/mile based on emission category. HCHO standards are at 0.020 g/mile for all vehicle emission categories, except ULEV400 at 0.042 g/mile. There are no partial soak or quick drive-away standards for MDVs.
- » **SFTP US06, Hot 1435 UC, and SC03.** Under LEV III, manufacturers can opt for the composite emission standards instead of the stand-alone standards for US06 and SC03 to determine the NMOG+ NO_x and CO emission limits. Based on certification data, CO and PM have shown higher emissions in stand-alone tests, thus able to meet the composite standards. LEV IV removes the SFTP composite option to better control emissions for the majority of the vehicle emission categories, excluding the ULEV250 and ULEV200 in class 2b and ULEV400 and ULEV270 in class 3 that are only available in MYs 2026–2028 (noted under Table 6 and Table 7) and can still adhere to LEV III standards. LEV IV has more stringent SFTP NMOG+NO_x and PM stand-alone standards as vehicle emission categories become stricter and more relaxed stand-alone CO standards compared to the composite options. While LEV III has separate standards for SC03 cycle emissions, LEV IV sets the maximum NMOG+NO_x and CO emissions to not be over the FTP emission standards for each vehicle emission category, unlike the explicit SC03 stand-alone standards for LDVs.
- » MDVs have a SFTP NMOG+NO_x, CO, and PM standards phase-in schedule, in which the minimum percentage of projected vehicles sales that follows LEV IV increases from 0% in 2026, to 30% in 2027, 60% in 2028 and 100% by 2029, while the remainder can be certified to LEV III standards. In lieu of this phase-in schedule, a SVM may certify 100% of its MDV fleet to the LEV III standards until MY 2029 and switch to LEV IV in MYs 2030+.
- » **Evaporative emission standards.** Similar to the LDV standards, the running loss emission standards is 0.05 g/mile of hydrocarbons in LEV III and reduces to 0.01 g/mile in LEV IV.

NMOG+ NOX CREDIT/VALUE ACCOUNTING

This section provides more context on how NMOG+NO_x credits (or debits) are generated if automakers succeed or fail to comply with the emission standards. Equation 1 shows the credits (or debits) calculation by LDV or MDV fleet for each manufacturer under LEV IV. Credits (or debits) in g/mile are calculated by multiplying the difference between LDV or MDV fleet average emissions required and calculated by total LDVs or MDVs produced and sold in California or Section 177 states.

$$\text{Credits (or Debits)} = (\text{Fleet Average required} - \text{Fleet Average calculated}) \\ \times \text{Total vehicles}$$

(Equation 1)

There are several changes in the manufacturer's LDV and MDV fleet average calculation methods between LEV III and LEV IV. Under LEV III, the LDV fleet average calculation, in general, is based on the adjusted sales-weighted average of all the vehicle emission categories, including ZEVs and PHEVs. The credit (or debit) calculation also uses Equation 1. However, as mentioned above, LDV fleet average calculated emissions under LEV IV will eventually phase out ZEVs by 2029. PHEVs will still be included in the fleet average calculation without emission adjustment in MY 2029+. Under LEV III, the credit (or debit) is calculated based on vehicle-specific formulas. Under LEV IV, the MDV fleet average calculation follows Equation 1. To prevent backsliding on fleet emissions, LEV IV do not include ZEVs in the fleet average calculation despite the growing volume of medium-duty ZEVs.

The emission credits earned in a model year may be used up to five subsequent model years. A manufacturer can offset debits in a model year by earning emission credits in the same amount as debits, applying additional credits earned in previous model years, or acquiring credits from other manufacturers. The debits must be equalized within three model years. A failure to comply is subject to a \$5,000 fine (inflation adjusted) for each failed vehicle. The amount of failed vehicles are determined as the quotient of the total amount of g/mile NMOG+NO_x emission debits and the g/mile fleet average required for the model year the debits were first incurred for LDVs in both LEV regulations and MDVs in LEV IV.

There are other mechanisms for manufacturers to earn additional NMOG+NO_x emission credits under both LEV III and LEV IV. Manufacturers receive a 0.005 g/mile FTP NMOG credit for extended, 150,000-mile warranty coverage. They can also receive a NMOG credit or value determined by CARB for direct ozone reduction systems.